

WHAT IS CLAIMED IS:

1. An image display apparatus comprising:
 - a plurality of scan wirings;
 - a plurality of modulation wirings for
- 5 constituting a matrix wiring together with the scan wirings;
- display elements to be driven in matrix according to a scan signal applied by the scan wirings and a modulation signal applied by the
- 10 modulation wirings;
- a scan circuit for selecting the plurality of scan wirings one after another and applying a scan signal to the selected scan wiring;
- an output circuit for storing an input signal
- 15 to be inputted in time-series, generating a plurality of outputs consisting of a time-series signal for generating a modulation signal based on the stored result and outputting the plurality of outputs to a plurality of output paths as parallel outputs; and
- 20 a modulation side drive circuit for outputting parallel modulation signals based on the time-series signal for generating a modulation signal,
- wherein the modulation side drive circuit is provided in a plural form corresponding to each of
- 25 the plurality of output paths and each of the plurality of modulation side drive circuits supplies the modulation signal to a part of and a plurality of

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modulation wirings among the plurality of modulation wirings, and

wherein the output circuit starts to output at least one of the parallel outputs before storing the 5 input signal for constituting the rearmost end among respective rear ends of the parallel outputs.

2. An image display apparatus according to claim 1, wherein a plurality of outputs among the 10 parallel outputs are started to be outputted substantially simultaneously.

10.
3. An image display apparatus according to claim 1, wherein the signal to be inputted in time-series has first to Dth parts (D is an integer equal to or larger than 2) in the order of input in the output circuit, and the output circuit is for outputting the D parallel outputs based on each of the D parts and starts to output a first output 20 corresponding to the first part when a Dth output corresponding to the Dth part is ready to be outputted or later.

4. An image display apparatus according to claim 2, wherein the signal to be inputted in time-series has first to Dth parts (D is an integer equal to or larger than 2) in the order of input in the

output circuit, and the output circuit is for outputting the D parallel outputs based on each of the D parts and starts to output a first output corresponding to the first part when a Dth output 5 corresponding to the Dth part is ready to be outputted or later.

11. 5. 10. An image display apparatus according to claim 3, wherein the signal to be inputted in time-series has first to Dth parts (D is an integer equal to or larger than 2) in the order of input in the output circuit, the output circuit is for outputting the D parallel outputs based on each of the D parts, and starts to output a first output corresponding to 10 the first part substantially simultaneously with the start of output of a Dth output corresponding to the Dth part.

6. An image display apparatus according to 20 claim 4, wherein the signal to be inputted in time-series has first to Dth parts (D is an integer equal to or larger than 2) in the order of input in the output circuit, the output circuit is for outputting the D parallel outputs based on each of the D parts, 25 and starts to output a first output corresponding to the first part substantially simultaneously with the start of output of a Dth output corresponding to the

Dth part.

14.

7. An image display apparatus according to
claim 5, wherein the signal to be inputted in time-
series has first to Dth parts (D is an integer equal
5 to or larger than 2) in the order of input in the
output circuit, and the output circuit is for
outputting the D parallel outputs based on each of
the D parts and starts to output the D outputs
10 substantially simultaneously.

8.

8. An image display apparatus according to
claim 6, wherein the signal to be inputted in time-
series has first to Dth parts (D is an integer equal
15 to or larger than 2) in the order of input in the
output circuit, and the output circuit is for
outputting the D parallel outputs based on each of
the D parts and starts to output the D outputs
substantially simultaneously.

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16.

9. An image display apparatus according to
claim 1, wherein the signal to be inputted in time-
series has first to Dth parts (D is an integer equal
25 to or larger than 2) in the order of input in the
output circuit, and the output circuit is for
outputting the D parallel outputs based on each of
the D parts and finishes outputting the D outputs

substantially simultaneously.

3.

10. An image display apparatus according to claim 2, wherein the signal to be inputted in time-series has first to Dth parts (D is an integer equal to or larger than 2) in the order of input in the output circuit, and the output circuit is for outputting the D parallel outputs based on each of the D parts and finishes outputting the D outputs
10 substantially simultaneously.

12.

11. An image display apparatus according to claim 3, wherein the signal to be inputted in time-series has first to Dth parts (D is an integer equal 15 to or larger than 2) in the order of input in the output circuit, and the output circuit is for outputting the D parallel outputs based on each of the D parts and finishes outputting the D outputs substantially simultaneously.

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5.

12. An image display apparatus according to claim 4, wherein the signal to be inputted in time-series has first to Dth parts (D is an integer equal to or larger than 2) in the order of input in the 25 output circuit, and the output circuit is for outputting the D parallel outputs based on each of the D parts and finishes outputting the D outputs

substantially simultaneously.

13. An image display apparatus according to
claim 5, wherein the signal to be inputted in time-
series has first to Dth parts (D is an integer equal
to or larger than 2) in the order of input in the
output circuit, and the output circuit is for
outputting the D parallel outputs based on each of
the D parts and finishes outputting the D outputs
substantially simultaneously.

7.

14. An image display apparatus according to
claim 6, wherein the signal to be inputted in time-
series has first to Dth parts (D is an integer equal
15 to or larger than 2) in the order of input in the
output circuit, and the output circuit is for
outputting the D parallel outputs based on each of
the D parts and finishes outputting the D outputs
substantially simultaneously.

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15. An image display apparatus according to
claim 7, wherein the signal to be inputted in time-
series has first to D th parts (D is an integer equal
to or larger than 2) in the order of input in the
output circuit, and the output circuit is for
outputting the D parallel outputs based on each of
the D parts and finishes outputting the D outputs

substantially simultaneously.

9.

16. An image display apparatus according to
claim 8, wherein the signal to be inputted in time-
series has first to Dth parts (D is an integer equal
to or larger than 2) in the order of input in the
output circuit, and the output circuit is for
outputting the D parallel outputs based on each of
the D parts and finishes outputting the D outputs
substantially simultaneously.

17. An image display apparatus according to
any one of claims 1 to 16, wherein an input signal to
be inputted in the output circuit in time-series in
15 order to output the plurality of parallel outputs is
n time-series input signals for generating n
modulation signals to be supplied in parallel with
each other to the modulation wirings, the output
circuit is for storing the n time-series input
20 signals in first to Dth memories (D is an integer
equal to or larger than 2) one after another in the
order of input, and each of the memories is for
writing the input signal in an address designated by
a write address to be given and reading a signal
25 written in an address designated by a read address to
be given,

wherein a write address to be given to an Xth

memory ($1 \leq X \leq D$) changes during a period from the time when an $n(X-1)/D+1$ th input signal among the n input signals is inputted until the time when nX/D th input signal is inputted in the order of 1 to n/D in

5 synchronism with the input signals, and

wherein the signal stored in each of the memories is read out by giving the read address to each memory and an output from each memory is outputted as the D parallel outputs.

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18. An image display apparatus according to
claim 17, wherein the read address to be given to the
Xth memory ($1 \leq X \leq D$) changes during a period from the
time when $n(D-1)/D+1$ th input signal among the n input
signals is inputted until the time when n/D th input
signal among the next n input signals is inputted in
the order of 1 to n/D .

19. An image display apparatus according to
20 claim 18, wherein the read address to be given to the
Xth memory ($1 \leq X \leq D$) changes using an entire period
from the time when $n(D-1)/D+1$ th input signal among
the n input signals is inputted until the time when
 n/D th input signal among the next n input signals is
25 . inputted in the order of 1 to n/D .

20. An image display apparatus according to

claim 1, further comprising a delay circuit, wherein the signal to be inputted in time-series has first to Dth parts (D is an integer equal to or larger than 2) in the order of input in the output circuit, the 5 output circuit is for outputting the D parallel outputs based on each of the D parts and starting to output at least one output among the D outputs earlier than starting to output other outputs, and the delay circuit is for delaying inputting the 10 output which is started to be outputted earlier in the modulation side drive circuit.

21. An image display apparatus according to
claim 1, further comprising a delay circuit, wherein
15 the signal to be inputted in time-series has first to
Dth parts (D is an integer equal to or larger than 3)
in the order of input in the output circuit, the
output circuit is for outputting the D parallel
outputs based on each of the D parts and starts to
20 output each of first to D-2th outputs corresponding
to the first to D-2th parts, respectively, earlier
than output of D-1th part and Dth part, and the delay
circuit is for delaying inputting each of the first
to D-2th outputs in each of the modulation side drive
25 circuits.

22. An image display apparatus according to

claim 1, wherein the signal to be inputted in time-series has first to Dth parts (D is an integer equal to or larger than 3) in the order of input in the output circuit, the output circuit is for outputting the D parallel outputs based on each of the D parts and starting an Xth output ($1 \leq X \leq D-1$) at a delay of a first predetermined period from the start of input of the first part and starting a Dth output at a delay of a second predetermined period from the start of input of the first part, where the first predetermined period is X/D of a reference period that is a period required for inputting the first to Dth parts and the second predetermined period is $(D-1)/D$ of the reference period, and wherein a delay circuit for giving a delay to an Xth output ($1 \leq X \leq D-2$) is further provided and a delay amount by the delay circuit is $(D-X-1)/D$ of the reference period.

23. An image display apparatus according to claim 1 or any one of claims 20 to 22, wherein the input signal to be inputted in the output circuit in time-series in order to output the plurality of parallel outputs is n time-series input signals for generating n modulation signals to be supplied in parallel with each other to the modulation wirings, the output circuit is for storing the n time-series

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input signals in first to Dth memories (D is an integer equal to or larger than 3) one after another in the order of input, and each of the memories is for writing the input signals in an address 5 designated by a write address to be given and reading an signal written in an address designated by a read address to be given,

wherein a write address to be given to an Xth memory ($1 \leq X \leq D$) changes during a period from the time 10 when an $n(X-1)/D+1$ th input signal among the n input signals is inputted until the time when nX/D th input signal is inputted in the order of 1 to n/D in synchronism with the input signals,

wherein the read address to be given to the Xth 15 memory ($1 \leq X \leq D-1$) changes during a period from the time when $nX/D+1$ th input signal among the n input signals is inputted until the time when nX/D th input signal among the next n input signals is inputted in the order of 1 to n/D ,

20 wherein a read address to be given to the Dth memory changes in the same manner as a read address to be given to a D-1th memory, and

wherein an output from each memory is outputted as the D parallel outputs.

25

24. An image display apparatus according to claim 23, wherein the input signal to be inputted in

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the output circuit in time-series in order to output the plurality of parallel outputs is n time-series input signals for generating n modulation signals to be supplied to the modulation wirings in parallel,

5 the output circuit is for storing the n time-series input signals in first to Dth memories (D is an integer equal to or larger than 3) one after another in the order of input, and each of the memories is for writing the input signals in an address to be

10 designated by a write address to be given and reading a signal written in an address designated by a read address to be given,

wherein a write address to be given to an Xth memory ($1 \leq X \leq D$) changes during a period from the time 15 when an $n(X-1)/D+1$ th input signal among the n input signals is inputted until the time when nX/D th input signal is inputted in the order of 1 to n/D in synchronism with the input signals,

wherein the read address to be given to the Xth 20 memory ($1 \leq X \leq D-1$) changes using an entire period from the time when $nX/D+1$ th input signal among the n input signals is inputted until the time when nX/D th input signal among the next n input signals is inputted in the order of 1 to n/D ,

25 wherein a read address to be given to the Dth memory changes in the same manner as a read address to be given to a D-1th memory, and

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wherein an output from each memory is outputted as the D parallel outputs.

25. An image display apparatus according to
5 claim 1, wherein the plurality of modulation side
drive circuits are for supplying modulation signals
to the same number of the modulation wirings,
respectively.

10 26. An image display apparatus according to
any one of claims 1 to 8, wherein the number of
modulation wirings to which each of the plurality of
modulation side drive circuits supplies a modulation
signal is not the same number.

15

27. An image display apparatus according to
claim 26, wherein: the signal to be inputted in time-
series has first to Dth parts (D is an integer equal
to or larger than 2) in the order of input in the
20 output circuit; the output circuit is for outputting
the D parallel outputs based on each of the D parts;
and the number of modulation wirings to which the
modulation side drive circuit, in which a first
output corresponding to the first part is inputted,
25 supplies a modulation signal is fewer than the number
of modulation wirings to which the modulation side
drive circuit, in which a Dth output corresponding to

the Dth part is inputted, supplies a modulation signal.

28. An image display apparatus according to claim 26, wherein the input signal to be inputted in time-series in the output circuit in order to output the plurality of parallel outputs is n time-series input signals for generating n modulation signals to be supplied in parallel with each other to the modulation wirings and satisfies a condition:

$$\begin{aligned} \overbrace{d[X]} &\leq M \left(d[D] + \sum_{x=1}^X d[x] \right) \quad [X = 1 \sim D-1] \\ d[D] &\leq M \left(\sum_{x=1}^D d[x] \right) \end{aligned}$$

• • • (1)

when the output circuit turns the n time-series input signals into first to Dth parts (D is an integer equal to or larger than 2) in the order of input and outputs an output corresponding to each part as the plurality of parallel outputs, a ratio of the number of modulation wirings to which the modulation side drive circuit, in which an output corresponding to each part is inputted, supplies the modulation signal is $d[1]:d[2]:\dots:d[D-1]:d[D]$, and a transfer speed of

a signal in each of the output paths is a speed M times as large as the input speed of the input signal.

29. An image display apparatus according to claim 26, wherein the input signal to be inputted in time-series in the output circuit in order to output the plurality of parallel outputs is n time-series input signals for generating n modulation signals to be supplied in parallel with each other to the modulation wirings and satisfies a condition:

$$d[X] = M \left(d[D] + \sum_{x=1}^X d[x] \right) \quad [X = 1 \sim D-1]$$

$$d[D] = M \left(\sum_{x=1}^D d[x] \right)$$

... (2)

when the output circuit turns the n time-series input signals into first to Dth parts (D is an integer equal to or larger than 2) in the order of input and outputs an output corresponding to each part as the plurality of parallel outputs, a ratio of the number of modulation wirings to which the modulation side drive circuit, in which an output corresponding to each part is inputted, supplies the modulation signal is $d[1]:d[2]:\dots:d[D-1]:d[D]$, and a transfer speed of

a signal in each of the output paths is a speed M times as large as the input speed of the input signal.

30. An image display apparatus according to
5 claim 1, wherein the output circuit has a memory for
carrying out the storage and a memory for storing at
least the Dth part is a memory capable of
nonexclusively carrying out writing and reading.

10 31. An image display apparatus according to
claim 30, wherein the memory for storing the first
part is a memory capable of nonexclusively carrying
out writing and reading.

15 32. An image display apparatus according to
claim 1, wherein: the signal to be inputted in time-
series has first to Dth parts (D is an integer equal
to or larger than 2) in the order of input in the
output circuit; the output circuit is for outputting
20 the D parallel outputs based on each of the D parts;
memories are provided corresponding to each of the D
output paths for outputting the D outputs; at least
one of the D memories has two memory blocks for
nonexclusively carrying out writing and reading; and
25 after a part of corresponding parts among the D parts
is written in one memory block, the two memory blocks
carry out writing of the subsequent part in the other

memory block and reading of a signal from the memory block in which a part of the input signal is written previously while causing at least a part of the writing and reading to overlap each other.

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37.

33. An image display apparatus according to claim 32, wherein each of the D memories has the two memory blocks.

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34. An image display apparatus according to claim 32, in which one of the parallel outputs is constituted by signals read out from each of the two memory blocks one after another, the apparatus further comprising a delay circuit for alleviating deviation in starting of input of each of the parallel outputs in each of the modulation side drive circuits.

39.

35. An image display apparatus according to claim 33, in which one of the parallel outputs is constituted by signals read out from each of the two memory blocks one after another, the apparatus further comprising a delay circuit for alleviating deviation in starting of input of each of the parallel outputs in each of the modulation side drive circuits.

35.

36. An image display apparatus according to claim 32, wherein when numbers are allocated to memory blocks, which are provided two for each of the first to Dth outputs, in the order of inputting the 5 input signals, the number of input signals to be written in a memory block of an odd number and the number of input signals to be written in a memory block of an even number satisfy the following expression:

10 $1/D \leq \text{the number of input signals to be written in a memory block of an odd number} / \text{the number of input signals to be written in a memory block of an even number} \leq D$, and

15 wherein the number of input signals to be written in each memory block is equal to or more than $1/D(D+1)$ times and equal to or less than $D/D(D+1)$ times the total number of modulation wirings through which each modulation side drive circuit supplies a modulation signal.

20

36.

37. An image display apparatus according to claim 33, wherein when numbers are allocated to memory blocks, which are provided two for each of the first to Dth outputs, in the order of inputting the 25 input signals, the number of input signals to be written in a memory block of an odd number and the number of input signals to be written in a memory

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block of an even number satisfy the following expression:

1/D ≤ the number of input signals to be written in a memory block of an odd number/the number of
5 input signals to be written in a memory block of an even number ≤ D, and

wherein the number of input signals to be written in each memory block is equal to or more than 1/D(D+1) times and equal to or less than D/D(D+1)
10 times the total number of modulation wirings through which each modulation side drive circuit supplies a modulation signal.

34.

~~38.~~ ^{33.} An image display apparatus according to
15 claim ~~34.~~ ^{33.} wherein when numbers are allocated to memory blocks, which are provided two for each of the first to Dth outputs, in the order of inputting the input signals, the number of input signals to be written in a memory block of an odd number and the
20 number of input signals to be written in a memory block of an even number satisfy the following expression:

1/D ≤ the number of input signals to be written in a memory block of an odd number/the number of
25 input signals to be written in a memory block of an even number ≤ D, and

wherein the number of input signals to be

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written in each memory block is equal to or more than
1/D(D+1) times and equal to or less than D/D(D+1)
times the total number of modulation wirings through
which each modulation side drive circuit supplies a
5 modulation signal.

40.
39. An image display apparatus according to
claim 35, wherein when numbers are allocated to
memory blocks, which are provided two for each of the
10 first to Dth outputs, in the order of inputting the
input signals, the number of input signals to be
written in a memory block of an odd number and the
number of input signals to be written in a memory
block of an even number satisfy the following
15 expression:

1/D \leq the number of input signals to be written
in a memory block of an odd number/the number of
input signals to be written in a memory block of an
even number \leq D, and
20 wherein the number of input signals to be
written in each memory block is equal to or more than
1/D(D+1) times and equal to or less than D/D(D+1)
times the total number of modulation wirings through
which each modulation side drive circuit supplies a
25 modulation signal.

36.
40. An image display apparatus according to

any one of claims 32 to 39, wherein when numbers are allocated to memory blocks, which are provided two for each of the first to Dth outputs, in the order of inputting the input signals,

5 if X is an odd number from 1 to 2D-3 and 2D,
the number of input signals to be written in an Xth
memory block is $D/D(D+1)$ times the total number of
modulation wirings to which each modulation side
drive circuit supplies a modulation signal, and

10 if X is an even number from 2 to 2D-2 and 2D-1,
the number of input signals to be written in an Xth
memory block is $1/D(D+1)$ times the total number of
modulation wirings to which each modulation side
drive circuit supplies a modulation signal.

15

41. An image display apparatus according to claim 1, wherein transfer speeds of the plurality of parallel outputs are substantially equal.

20 42. An image display apparatus according to
claim 1, wherein the signal to be inputted in time-
series has first to Dth parts (D is an integer equal
to or larger than 2) in the order of input in the
output circuit, the output circuit is for outputting
25 the D parallel outputs based on each of the D parts,
and the D parallel outputs are started to be inputted
in each of the modulation side drive circuits

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substantially simultaneously.

43. An image display apparatus according to
claim 1, in which an R input signal, a G input signal
5 and a B input signal are inputted respectively, and
the output circuits are provided for the input
signals of each color, the apparatus further
comprising a composition circuit for composing
outputs to be outputted to the same modulation side
10 drive circuit among the plurality of parallel outputs
of each output circuit.

44. An image display apparatus according to
claim 1, wherein the display element is an electron-
15 emitting element.

45. An image display apparatus comprising:
a plurality of scan wirings;
a plurality of modulation wirings constituting
20 a matrix wiring together with the scan wirings;
display elements driven in matrix according to
a scan signal to be applied by the scan wirings and a
modulation signal applied by the modulation wirings;
a scan circuit for selecting the plurality of
25 scan wirings one after another and applying a scan
signal to the selected scan wiring;
an output circuit including a first output

1 circuit for storing an input signal for displaying a
2 first color to be inputted in time-series and
3 generating D outputs (D is an integer equal to or
4 larger than 2) consisting of time-series signals for
5 generating modulation signals based on the stored
6 result to output the D outputs to D output paths as
7 parallel outputs, a second output circuit for storing
8 an input signal for displaying a second color to be
9 inputted in time-series and generating D outputs
10 consisting of time-series signals for generating
11 modulation signals based on the stored result to
12 output the D outputs to D output paths as parallel
13 outputs, and D composition circuits for composing
14 outputs that are outputted to an Xth output path
15 (1≤X≤D) among the D output paths to which the outputs
16 from the first output circuit are outputted and an
17 Xth output path (1≤X≤D) among the D output paths to
18 which the outputs from the second output circuit are
19 outputted respectively; and
20 a modulation side drive circuit for outputting
21 parallel modulation signals based on time-series
22 signals for generating modulation signals to be
23 outputted from the composition circuit,
24 wherein the modulation side drive circuit is
25 provided in plural forms associated with each of the
D composition circuits and each of the plurality of
modulation side drive circuits supplies the

modulation signal to a part of and a plurality of modulation wirings among the plurality of modulation wirings,

wherein the display elements are arranged such

5 that a plurality of display elements to which the scan signals are given simultaneously by one scan wiring include a display element for displaying the first color and a display element for the second color, and

10 wherein the composition circuit is for composing outputs from the first output circuit and the second output circuit according to the arrangement of the display element for displaying the first color and the display element for displaying

15 the second color.

46. An image display apparatus comprising:

a plurality of scan wirings;

a plurality of modulation wirings constituting

20 a matrix wiring together with the scan wirings;

display elements to be driven in matrix according to a scan signal applied by the scan wirings and a modulation signal applied by the modulation wirings;

25 a scan circuit for selecting the plurality of scan wirings one after another and applying a scan signal to the selected scan wiring;

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an output circuit including a first output circuit for storing an input signal for displaying red to be inputted in time-series and generating D outputs (D is an integer equal to or larger than 2) 5 consisting of time-series signals for generating modulation signals based on the stored result to output the D outputs to D output paths as parallel outputs, a second output circuit for storing an input signal for displaying green to be inputted in time- 10 series and generating D outputs consisting of time-series signals for generating modulation signals based on the stored result to output the D outputs to D output paths as parallel outputs, a third output circuit for storing an input signal for displaying 15 blue to be inputted in time-series and generating D outputs consisting of time-series signals for generating modulation signals based on the stored result to output the D outputs to D output paths as parallel outputs, and D composition circuits for 20 composing outputs that are outputted to an Xth output path ($1 \leq X \leq D$) among the D output paths to which the outputs from the first output circuit are outputted, an Xth output path ($1 \leq X \leq D$) among the D output paths to which the outputs from the second output circuit 25 are outputted, and an Xth output path ($1 \leq X \leq D$) among the D output paths to which the outputs from the third output circuit are outputted respectively; and

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a modulation side drive circuit for outputting parallel modulation signals based on time-series signals for generating modulation signals to be outputted from the composition circuit,

5 wherein the modulation side drive circuit is provided in plural forms associated with each of the D composition circuits and each of the plurality of modulation side drive circuits supplies the modulation signal to a part of and a plurality of 10 modulation wirings among the plurality of modulation wirings,

 wherein the display elements are arranged such that a plurality of display elements to which the scan signals are given simultaneously by one scan 15 wiring include a display element for displaying red, a display element for displaying green and a display element for displaying blue, and

 wherein the composition circuit is for composing outputs from the first output circuit, the 20 second output circuit and the third output circuit according to the arrangement of the display element for displaying red, the display element for displaying green and the display element for displaying blue.

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